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MAXWELL'S EARLY CAREER

by

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P.M. Harman, *The scientific letters and papers of James Clerk Maxwell. Volume 1. 1846–1862.* Cambridge University Press, 1990. Pp. xxvii + 748, £125.00. ISBN 0–521–25625–9

James Clerk Maxwell (1831–1879) was arguably the most important British physicist in the latter half of the last century; a period in which there was some stiff competition from, for example, William Thomson (Lord Kelvin) and G.G. Stokes. With Darwin and Faraday he is among the men of science of the 19th century most widely admired by modern scientists. The reasons for this are not hard to find. His work had a lasting impact on physics and he pursued the subject both experimentally and mathematically in ways very similar to the methods of modern science: especially in the mathematical representation of physical quantities.

Maxwell has been the subject of much scholarly study in recent years, but no scholarly biography of him has appeared or, so far as I am aware, is in progress. Furthermore, his immediate followers, the Maxwellians, have also been studied extensively. The lack of biography and concentration on followers might be taken to be a little curious except for the fact that a surprisingly small quantity of manuscript material has survived, for someone of his eminence. One of the reasons for this is obvious. His house, Glenlair, was destroyed by fire and it seems likely that much of his archive was consumed in the flames. However, the manuscript writings of any individual fall into two groups, those that are kept by the writer and those that are sent as letters to friends and colleagues. Here the fate of Maxwell's manuscripts becomes more problematic. Of course those letters he wrote to his father and wife would most likely have been destroyed in the fire. But many of his letters to, for example, Stokes and Thomson, which should be in their archives, have simply disappeared, leaving no trace. Furthermore, much of his incoming correspondence has not survived, presumably because it too was destroyed in the fire.

Harman in the general introduction provides an excellent guide to the history of Maxwell's papers that had not gone to Glenlair and which are now mostly

deposited in various libraries in Cambridge. Considering the importance of Maxwell and the history of his archive, this first volume (of three) of his scientific letters and papers is to be welcomed.

A further consequence of the loss of many of Maxwell's papers is that all writers on Maxwell have had to rely heavily on the manuscripts that were published in Campbell & Garnett's *Life of Maxwell* (1st edition 1882, 2nd edition 1884). This volume is no exception. Of the 196 texts reproduced here (of which 138 are letters and the remaining 58 are scientific papers of one sort or another), 60 come from Campbell & Garnett (plus the appendix to one of the letters); there is no other source for them. Hence it is necessary to gauge how accurate they were in their editing and choice of material. Lewis Campbell (1830–1908), a life-long friend of Maxwell's, was a distinguished classical scholar (becoming Professor of Greek at St Andrews in 1863), and William Garnett (1850–1932) had been Maxwell's demonstrator at the Cavendish Laboratory (later becoming Professor of Mathematics at Nottingham and subsequently Durham, before embarking on a career in educational administration). Thus they were well qualified to write about Maxwell, and Campbell was well used to dealing critically with texts.

However, in the genre of Victorian lives and letters, authors and editors came to praise their subjects, not to analyse them historically. Nevertheless, the habit of providing transcriptions of manuscripts is useful if it subsequently becomes the only source of material, as in this case. Unfortunately, Campbell & Garnett do not usually top and tail the letters (which many other contemporary authors and editors did do), so there is no reliable way of telling how much they edited out of a letter. If we look at one of the very few surviving manuscripts that was published in Campbell & Garnett (p. 221), only one paragraph is given of Maxwell's letter of 28 November 1855 to R.B. Litchfield. Yet in Harman's edition the full letter (number 81) has six paragraphs.

The great virtue of this volume is that it brings together in one volume the majority of Maxwell's writings from several sources (15 archives and a few miscellaneous printed sources in addition to Campbell & Garnett). Of the texts, 62 are from previously unpublished manuscripts and an additional 58 from manuscript sources (leaving 86 derived entirely from printed sources including Campbell & Garnett). It is the fact of their combination in a chronological sequence, edited to a high and uniform standard as well as being superbly printed (with very few typos), that gives the volume its value as a research tool with which to work on Maxwell and 19th-century physical science generally.

However, I must say that I disagree profoundly with Harman's editorial decision to select material from the extant Maxwell archive. The archive is very small when compared with surviving manuscripts of many contemporaries of the same stature. For example, the archives of John Herschel, Thomson,

Stokes, Darwin and Airy each run into tens of thousands of items. One of the great problems in providing source material on 19th-century scientists is deciding what to publish out of a vast bulk of available material without being, or seeming to be, arbitrary or biased in one's selection. This problem I feel does not apply to Maxwell because of the small size of the extant archive. Harman makes it clear in the title and in his introductory material that he is concerned only with publishing scientific and mathematical papers and letters by Maxwell. In my view the inclusion of the material that Harman has excluded would have made the volume more valuable than it already is. It is clearly sensible to exclude Maxwell's undergraduate notes as these are entirely derivative. However, in the case of letters *to* Maxwell and of non-scientific material, the decisions that Harman took are open to discussion.

Harman excludes letters to Maxwell written by both scientists and non-scientists. Such letters are symbiotically as important as the letters Maxwell wrote. Although, as Harman says, there are very few occasions with Maxwell where both sides of a correspondence have survived in a continuous sequence, the inclusion of letters to Maxwell would have provided clues as to his interests at a given time. Harman does say that in the following two volumes he will include some incoming letters, especially from P.G. Tait, but there are no such letters in this volume. What Harman does here is to give extended extracts of such letters in the notes to appropriate texts.

A more difficult problem is presented by the exclusion of what Harman classifies as non-scientific material (including the abridgement, by Harman, of some of the letters in Campbell & Garnett). Had this material been included (incidentally all this excluded material is listed in the appendix) then the extracts of Maxwell's letters to his father and his future wife, in Campbell & Garnett, would have been published here. Many of those to his father are published as very short extracts in Campbell & Garnett and the decision to exclude them from the main text may have been a wise one, but perhaps they could have been put in an appendix. However, the exclusion of letters to his wife does seem to be fairly arbitrary. These give some revealing insights into Maxwell's deep religious beliefs (and thus his general view of the world). The letter where Maxwell discusses the scientific role of the wives of various scientists can surely only have been excluded by an overly narrow conception of what is scientific. Such a decision seems even odder when Maxwell's letter to John Westlake of 9 June 1857, supporting the abolition of celibacy for college fellows, is included as number 125.

The inclusion of all that survived the destruction would have made the volume seem more patchy; yet I don't think this would have made much difference to its overall coherence, which is good. One can only work with what has survived and it is very unfortunate that the destruction rate was so high.

Although the publication of all extant Maxwell manuscripts and letters to him would undoubtedly have increased the component of the volume drawn solely from Campbell & Garnett, this does not seem, to me, to be sufficient reason for exclusion, bearing in mind that nearly a third of the texts are drawn from that source in any case. To read the full extant Maxwell corpus, one will still have to go beyond this volume to Campbell & Garnett and to various archives.

Given these reservations as to editorial selection, what does the content of the volume cover? It opens in 1846 with Maxwell at the age of 14, and traces him through his career as an undergraduate at the University of Edinburgh and at Peterhouse and later Trinity College, Cambridge, his professorship at Aberdeen and halfway through his professorship at King's College London, ending in 1862. As a Cambridge undergraduate his abilities were already apparent. J.D. Forbes wrote in 1850, 'he is not a little uncouth in manners, but withal one of the most original young men I have ever met with, & with an extraordinary aptitude for physical enquiry'.

Like many of the top Cambridge mathematical physicists of the day, he came under the coaching of William Hopkins. Hopkins's task was to prepare candidates for the competitive Tripos examination. In January 1854 Maxwell was second Wrangler and joint Smith's Prizeman (E.J. Routh being the opposition in both cases). Maxwell was elected a Fellow of Trinity College in October 1855, but was appointed Professor of Natural Philosophy at Aberdeen in late 1856. He held this position until 1860, when he was made redundant because of the merger of the two colleges at Aberdeen, whereupon he was appointed Professor of Natural Philosophy at King's College London.

Maxwell's first interest in electro-magnetism, the subject that above all else made his name, occurs in a letter to Thomson written shortly after graduation. In this he asks what he should read of Ampère and Faraday about the subject (number 45). (The study of electricity was not then part of the Tripos syllabus.) Unfortunately Thomson's reply has not been found. However, by November 1854 Maxwell was discussing Faraday's field theory with Thomson (number 51). At this time Maxwell was also preoccupied with developing his theory of colour, and although electro-magnetism is discussed in subsequent letters to Thomson, it is not until the autumn of 1855 that the first draft of Maxwell's paper 'On Faraday's lines of force' was written (number 83). The paper was read to the Cambridge Philosophical Society in December 1855 and February 1856 (numbers 84, 85, 87). Maxwell then seems to have dropped the subject during 1856 as he worked on the stability of Saturn's rings. However, he sent a copy of the paper to Faraday. Faraday reciprocated later in the year by sending him his papers on gold and light and on the conservation of force (which drew a friendly response from Maxwell, suggesting, among other things, that Faraday could extend his methods to the study of gravitation (number

133)). What is particularly significant, and emerges clearly from this volume, is that Maxwell did not seriously return to the study of electricity until he moved to London; that is, until he came very much under Faraday's personal as well as intellectual influence. For example, it seems possible that Faraday informed him of the work of Verdet, although there is no reference to this in Faraday's letters to him (number 187). Faraday's influence on Maxwell cannot be overstated. As Maxwell wrote to him in October 1861 (number 187):

> When I began to study electricity mathematically, I avoided all the old traditions about forces acting at a distance, and after reading your papers as a first step to right thinking, I read the others, interpreting as I went on, but never allowing myself to explain anything by these forces. It is because I put off reading about electricity till I could do it without prejudice, that I think I have been able to get hold of some of your ideas.

This reaction to Faraday's theories is very different to that of Thomson, who was initially very dismissive, although he later became, with Maxwell, a strong champion of field theory.

By reading through the texts in this volume one can form a very good idea of how Maxwell went from one fundamental problem of physics to the next. When this volume concludes, Maxwell is about to enter the mature period of his researches, the culmination of which is his *Treatise on electricity and magnetism* of 1873. The next volume of his letters and papers will undoubtedly throw much light on the researches for, and composition of, this. I for one look forward to its publication with the hope that Harman will see fit to be more inclusive in his choice of texts.